A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

National Renewable Energy Laboratory

Innovation for Our Energy Future

Western Wind and Solar Integration Study

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August 14, 2008

earch Institute • Battelle

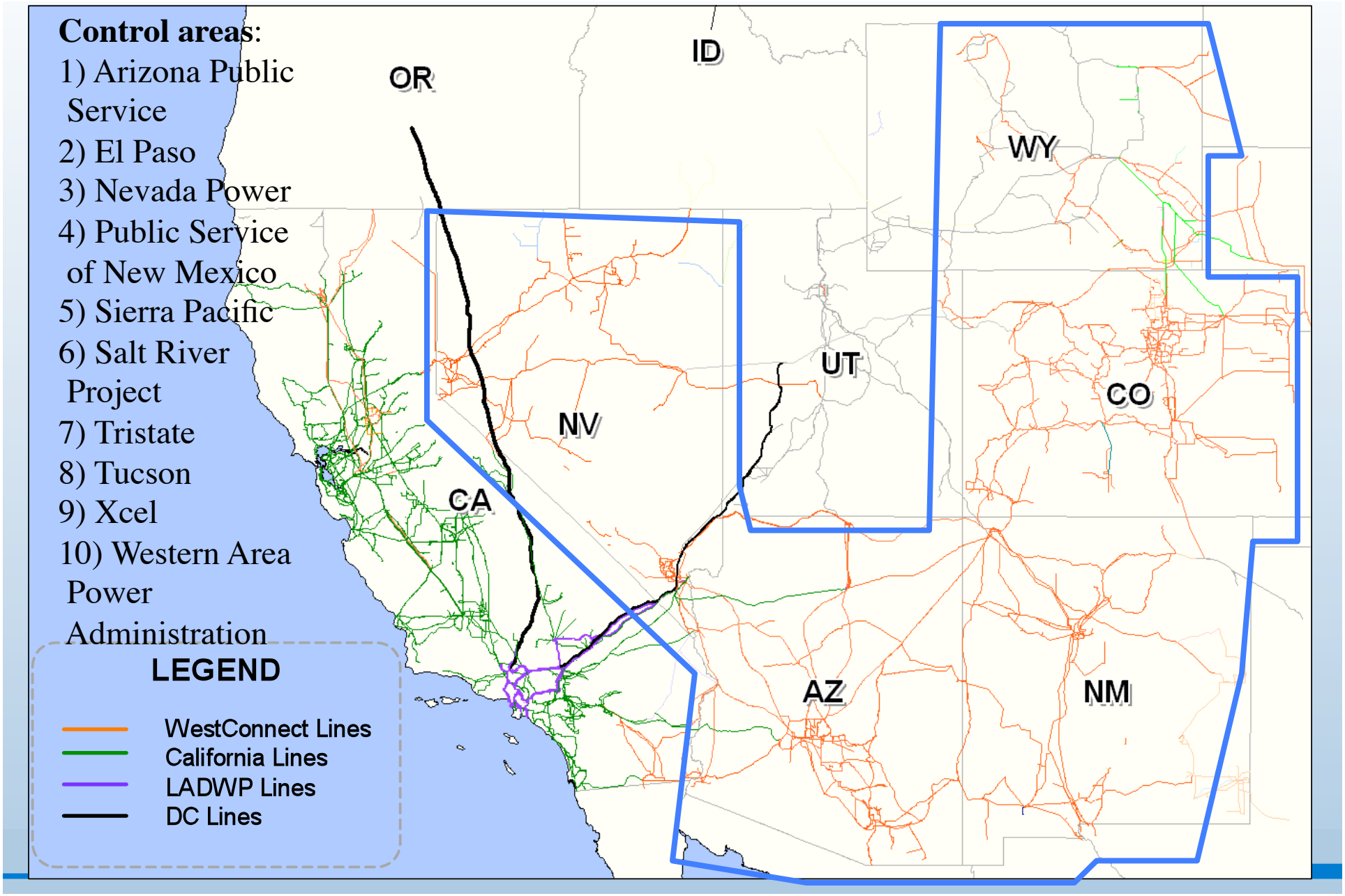
Agenda

- Introduction
- Solar Modeling
- Wind Modeling
- Base Scenarios and Data
- Lunch
- Statistical Analysis
- Production Simulation Analysis
- Break
- Scenarios for Future Analysis
- Discussion

Overview

- Goal
  - To understand the costs and operating impacts due to the variability and uncertainty of wind, PV and concentrating solar power (CSP) on the grid
  - Not the cost of wind or solar generation
- Issues
  - Does geographic diversity help?
  - How do local resources compare to out-of-state resources
  - Can balancing area cooperation help manage variability?
  - What is the benefit of wind forecasting?
  - How can hydro help with wind integration?
- Scope of study
  - Operations, not transmission study
  - Study year – 2017 to line up with WECC studies
  - Simulate load and climate of 2004, 2005, 2006 forecast to 2017
  - Simulate all of WECC but all subhourly variability accommodated by WestConnect

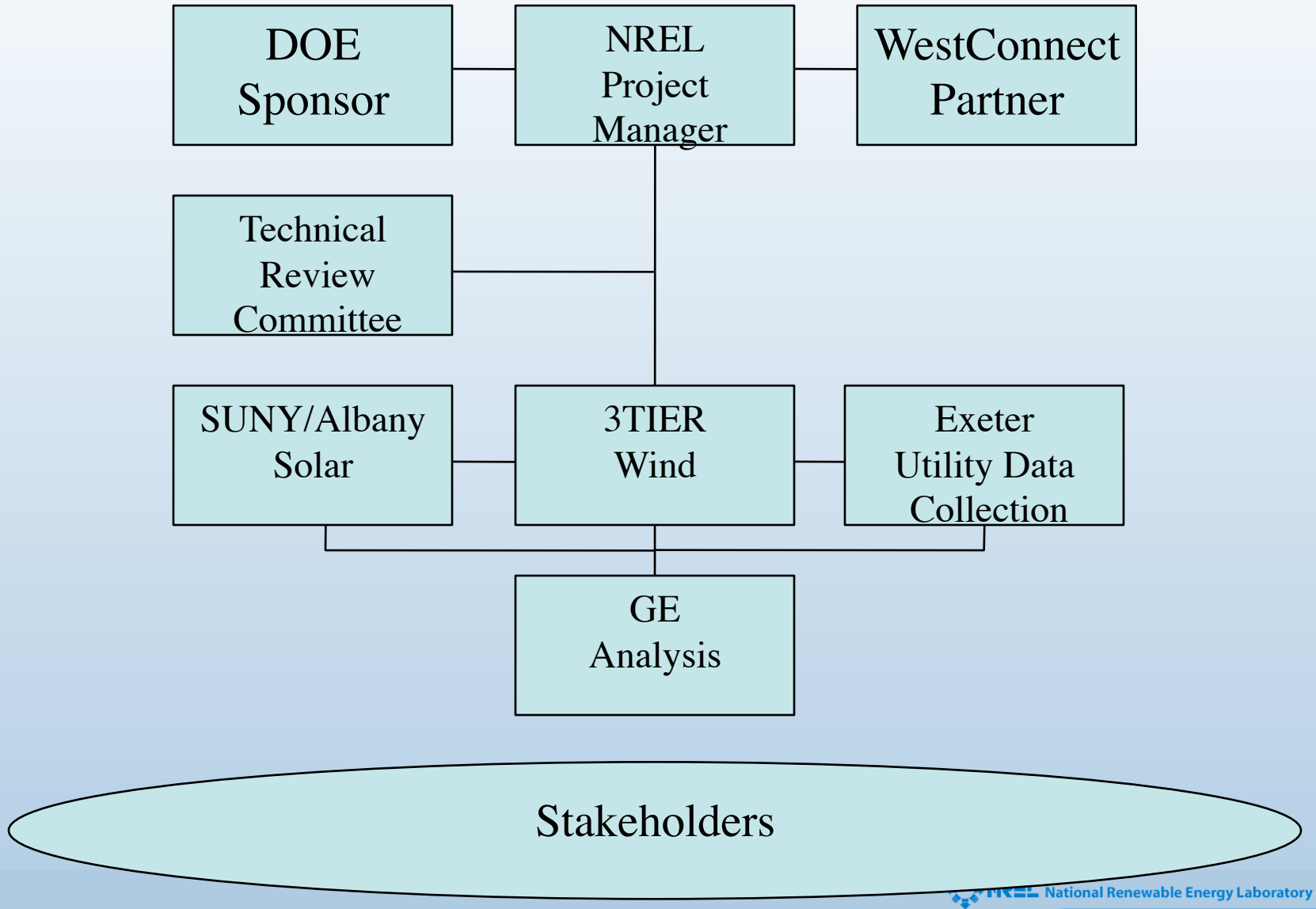
Study Footprint (WestConnect outside of California)



High Renewables Basecase 2017

	Wind	Solar PV	Concentrating Solar Power	Total
Study footprint (WestConnect)	30% by energy	1.5%	3.5%	35%
	29 GW	3 GW	3 GW	35 GW
Rest of WECC	20%	0.9%	2.1%	23%
	42 GW	4 GW	4 GW	50 GW
Total	71 GW	7 GW	4 GW	85 GW

Project Organization



Tasks and Schedule

- Stakeholder Meeting (5/23/07)
- Data Collection (second half '07)
  - Wind and solar mesoscale modeling (3TIER, SUNY, NREL)
  - Utility load, generator, transmission data (Exeter)
- Preliminary Analysis (first half '08) - GE
  - Extensive statistical analysis with various options for wind/solar sites and transmission
- Scenario Development (Aug '08) – GE
- Stakeholder Meeting (8/14/08)
- Run Scenarios (starts Aug '08) - GE
  - Examine costs due to regulation, load following, unit commitment
  - "Dives" to investigate issues such as Hoover
  - Examine mitigation strategies/options
  - Determine contributions to reliability and capacity value
- Preliminary Technical Results (end '08)
- Draft Report (May '09)
- Stakeholder Meeting
- Final Report (July '09)

Data Collection

- Wind
  - Resource modeling – 3TIER
  - Forecast modeling – 3TIER
  - Wind power conversion – 3TIER
- Solar
  - Resource modeling – SUNY
  - Forecast modeling – 3TIER
  - PV power conversion – NREL
  - CSP power conversion – NREL
- Utility data
  - Utility data – Exeter
  - Load flows – Exeter

Data Analysis

- Development of baseline, high renewables, and other scenarios
- Analysis of scenarios for climatological years of 2004, 2005, 2006
  - Statistical analysis
  - Production simulation analysis - hourly
  - Quasi-steady-state analysis – 1 minute
  - Evaluate various mitigation options: balancing area cooperation, storage, etc.
- Effective Load Carrying Capability and Loss of Load Probability Analysis

Thank You!

- WestConnect utilities
- Consultants
- NREL
- TRC
- Stakeholders
- DOE